

NOTES ON SOUTH AUSTRALIAN MARINE MOLLUSCA,
WITH DESCRIPTIONS OF NEW SPECIES, PART I.

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PLATE XXVI.

Dentalium intercalatum, Gould.

Proc. Bost. Soc. Nat. Hist. vii., p. 166 (1859); Otia, p. 119; Sowerby in Conch. Icon., xviii., pl. vii., fig. 45 (1872). Type locality, China Seas (North Pacific Expl. Exped.). Pilsbry in Tryon's Manual of Conchology, vol. xvii., p. 25, pl. xi., figs. 88, 89. *D. Bednalli*, Pilsbry & Sharp, Man. of Conch., vol. xvii., p. 248, pl. xxxix., figs. 1, 2, 3; type locality, St. Vincent Gulf (W. T. Bednall). *D. octogonum*, Angas (non Lam.), P.Z.S., 1878, p. 868, Henley Beach, S.A.

Angas misidentified our shell from Henley Beach as *D. octogonum*, Lam., and cited it as a South Australian shell in P.Z.S., 1878, p. 868. Pilsbry & Sharp, in Tryon's Man. of Conch., vol. xvii., p. 248, described a shell under the name of *D. Bednalli*, from St. Vincent Gulf, sent to them by Mr. W. T. Bednall. This name would stand, were it not that specimens of our extremely variable species are inseparable from *D. intercalatum*, Gould, 1859, which has priority.

I have examined more than three hundred individuals, dredged by me in St. Vincent and Spencer Gulfs, Investigator Strait, and Backstairs Passage. They have been taken alive at all depths between eight and twenty-two fathoms, chiefly in muddy bottoms. I have vainly endeavoured to discover more than one species among them. They are exceedingly variable, and were it not for intermediate forms, quite a dozen species might be created.

Its length varies, of course: firstly, with its age; individuals when very young are only 5 millimetres, when senile 37; secondly, with the amount of its posterior end which has been removed, so that a stouter, older shell may not be so long as another which is evidently younger and has not suffered so much truncation.

Its curvature is also very variable. In its early stage of growth it is well curved, but becomes gradually, though markedly, less so as it gets older. Since the posterior end is progressively removed, the mature shell has an appearance quite different from that of the immature, being nearly straight and bluntly truncated, instead of well curved and posteriorly acuminate. The same individual in its two extreme stages of growth, without the controlling intermediate

examples, might be excusably described as distinct species. This probably partly explains why the name of *D. Bednalli*, Pilsbry & Sharp, has been added to that of *D. intercalatum*, Gould, the former being an old individual, and the latter a young one.

One shell, compared in the Natural History Museum, London, with that labelled *D. intercalatum*, Gould, was identical, and represents our immature, curved, sharp-pointed stage. The figure given in Tryon's *Man. of Conch.* corresponds with it, as does also the description there transcribed, even to the origin of its secondary riblets, first in the two interspaces on the outer curve, and somewhat later in the lateral ones and on the concave side, as italicised in the manual. Hence, though the type locality of this species is given as China Seas, the identity of our South Australian form is indisputable.

The number of ribs very rarely remains the same throughout the entire length of the shell; thus one with eleven rather acute ribs at the posterior end has but eleven at the anterior. Almost always the ribs become more numerous with age. The increase is effected in two ways, by intercalation and by rib splitting.

1. By intercalation. Generally in the centre of an interspace a riblet arises, and gradually enlarges until it equals the original ribs. The stage of growth at which this begins is variable, not only in different shells, but in the several interspaces of the same shell. For instance, when the individual is quite immature every interspace may bear a riblet, whereas when senile there may be only the first indication of one. Again, one interspace may show a riblet very soon, and later, other interspaces may develop them at varying distances as in the typical *D. intercalatum*. Besides these secondary riblets, eventually tertiary riblets may arise in their interspaces and further multiply the costations. Still another variation is to be soon—instead of a single secondary costula arising in an interspace, two riblets of equal dimensions may develop simultaneously. This twin intercalation alone may be found in an example, or there may be every combination of single and double intercalation.

2. By rib-splitting. A groove begins to form in a rib, and gradually grows in depth and width until it divides it into two. This groove may begin on the centre or on any part of the side of the rib. The ribs so formed may subsequently be cut up by other grooves. Sometimes two or three of such furrows may appear on the same rib at the same time and enlarging at an equal rate form three or four subequal riblets.

The two methods, intercalation and rib-splitting, may occur alone in respective individuals, or both in the same example, and there may be any conceivable ratio between the two methods in different specimens.

The contour of the ribs may vary greatly. They may be at their inception narrow and comparatively high, and may so continue throughout their length. Or after some increase in size they may begin to decline in height until they almost fade out and leave the anterior part of the shell nearly smooth. Their shape may completely change; whereas, at first, they may have concave interstices so as to resemble a fluted column, the ribs may widen out and become convex, while their interstices become reduced to narrow, shallow grooves between broad, approximate, rounded ribs.

The number of ribs at the posterior end is very variable. If multiplication of costæ occurs, it is plain that the older the shell and the more truncated, the greater will be the number of ribs at the posterior extremity; and if such multiplication always began at the same stage of growth and was equally rapid, the number would always be greater with a greater truncation. But such is not the case, hence the number of ribs at the hinder end varies widely. Six is the fewest I have found. But there may be any number beyond this up to fourteen, which is the most yet observed. These larger numbers are by no means restricted to examples with much truncation, nor is there any definite proportion between the number of ribs and the diameter of the shell; some of large diameter at the truncation have but few, and *vice versa*. A diagnosis framed upon the number of ribs would be baseless. Pilsbry suggests the typical form is hexagonal; probably he is right, but usually there are more than six costæ.

The anal appendical tube is wanting in most cases, even during life. When present it may be two or three millimetres long. It may exist when the shell is young and narrow, and be wanting when old and wide; possibly it may have been broken off. It is central and most frequently in the axis of the shell. But it may be distinctly out of the axis, joined at an angle so as to point markedly towards the concave side, or slightly towards the convex, and in one it is funnel-shaped instead of cylindrical. These circumstances confirm the suggestion of its being an outgrowth subsequent to truncation, and not merely a residual inner layer of the shell after the outer portion has been absorbed.

The radula (pl. xxvi., figs. 14*a*, *b*, *c*, *d*) is comparatively large, and contains fifteen rows of teeth, with the formula 1.1.1.1.1. The rachidian tooth is about twice as wide as high, is thickened along its free edge, and thinned along

its attached border. The single lateral is stout and rather short, and has one obliquely placed cusp without serrations. The marginals are trapezoidal flat plates, thickened along their inner end, and the whole or larger part of their upper margin. Mr. Kesteven, in executing the drawings, detected a small accessory plate of chitin (fig. 14*d*). It is somewhat pyriform, stouter at its narrow, attached end, and thinner and slightly striate at its free, expanded extremity. Its height is about one-half that of the rachidian tooth, outside of which it stands, with its base about half-way between this and the lateral. As the laterals overlap the outer fourth or third of the rachidian, this plate lies behind or between the laterals, and being comparatively thin it cannot be seen through the much denser laterals; but in a dismembered radula it can be certainly recognised.

***Cadulus acuminatus*, Tate.**

This shell is first referred to as a South Australian species by G. F. Angas, in a paper entitled "A List of Additional Species of Marine Mollusca . . . of South Australia," in Proc. Zool. Soc. of November 5, 1878, p. 868, species 44, *Cadulus acuminatus* (?) Desh., M.S. in coll., Cuming; Holdfast and Aldinga Bays (Tate); also Port Jackson. In the Trans. and Proc. Roy. Soc. of South Australia, vol. ix., p. 194, 1887, Tate, in a paper of October 5, 1886, on "The Scaphopods of the Older Tertiary of Australia," includes *Cadulus acuminatus*, of which he gives a short description, cites it from the "oyster beds of the Upper Aldinga series," and says, "the species is not uncommon in shell sand on the shores of St. Vincent Gulf." In the Manual of Conchology, vol. xvii., p. 183, Pilsbry gives *C. acuminatus*, Tate, pl. xxxii., figs. 47, 48, 49, with a full description.

I have dredged it in St. Vincent and Spencer Gulfs and Investigator Straits and Backstairs Passage at five fathoms, (14 dead), at nine fathoms (29 dead and 3 alive), at seventeen fathoms (80 dead and 12 alive and 7 initial tubes), besides 35 dead and 5 alive at unrecorded depths. These living examples enable me to make some additions to and alterations in Pilsbry's description of what were doubtless beach-rolled specimens. Though glossy and smooth to the naked eye, under the microscope very fine, crowded transverse scratchings are visible. Though usually quite clear and glassy, but for the white opaque internal callous ring near the posterior end, many individuals have fine, milky, transverse lines, and some have opaque, white, subdistant, interrupted bands, or on one side a group of round or oval white blotches.

The posterior end has not a continuous, smooth margin, but is irregular, and has a minute, triangular spine, which projects from it at a very slight angle on the convex border of the shell (pl. xxvi., figs. 5 and 6). This end shows signs of fracture, and suggests that it is not the actual commencement of the shell, but has been broken off from an earlier segment.

Dredged with these are what at first sight appear to be another form of *Cadulus*, or a minute *Dentalium*, measuring up to four or five millimetres in length. These are curved like a juvenile *Dentalium*, and gradually increase in diameter and become less curved. They are evidently fractured at their attenuate posterior extremity, and show a minute, triangular projection from its margin on the convex side. After a very slight inflation near their anterior extremity they are constricted, and then begin to expand again into a funnel-shaped portion, which may measure one, two, or three millimetres in length. This end is irregular in outline and evidently fractured. The funnel is clear and glassy, whereas the dentalium-shaped tube is like ground glass from very fine, crowded, transverse, milky lines. Some individuals lack the funnel, and end at the constriction.

In one instance the posterior end of a *Cadulus acuminatus* has slipped into the funnel-shaped extremity of one of these shells, and allows a comparison to be made between them.

In my opinion this dentalium-like shell is the juvenile stage of the *Cadulus acuminatus*. When it has grown to a certain length and diameter there is a trifling inflation, then it becomes definitely constricted, somewhat obliquely, and then begins to expand to form the mature shell. After a time the earlier portion becomes detached at the constriction, and in the fracture a tiny, projecting spine is left on the adult portion at the convex side, which spine is a spicule of the juvenile shell just where it is becoming contracted.

If this deduction prove correct, and I have no doubt about it, probably all the species belonging to the group *Cadulus dentalinus* represent only immature stages of species in the *C. acuminatus* group. This will necessitate a careful re-examination of all these forms, and a considerable revision of their nomenclature.

The radula, which was difficult to get because the animals were dried up, shows a formula of 1.1.1.1.1. Thirteen rows can be counted; possibly there may be a few more in a complete ribbon. The rachidians are higher than wide, narrower at their attached end, where they are widely notched, with a wide, simple, flange-like cusp (pl. xxvi., figs. 1a, 1b, 1c); the laterals are rhomboidal, much larger and stouter, espe-

cially at their upper inner part, and are notched at their lower inner angle to form two small cusps. The marginals are not quite so large, are rhomboidal plates, and quite simple in outline. The laterals are very different from the rather remarkably shaped denticles of *C. propinqua*, figured in Man. of Conchology, vol. xvii., pl. xxxix., fig. 11.

***Leiopyrga octona*, Tate.**

Trans. Roy. Soc., S. Aust., vol. xiv., 1891, part ii., p. 260, pl. xi., fig. 5.

Dredging has supplied some living examples of this species, from which the operculum and radula have been obtained. The operculum (pl. xxvi., fig. 15) is horny and multispiral, five or six revolutions, with central nucleus. To the margin of the spirals is attached a thin membrane, rather less than half as wide as the spiral. It is radially striated with slightly wavy lines. From the earlier whorls it is absent, doubtless worn away, and is fragmentary and ragged on the next to the last whorl. The radula (pl. xxvi., figs. 16, 17, 18) has for its formula ∞ (5.1.5) ∞ . As the examples had been allowed to dry instead of being preserved in spirit, the radula was difficult to isolate, and not in perfect condition. There is a rachidian tooth nearly circular or quadrate, with a slight central projection of the free edge. Then follow five laterals on each side, with a thickened outer border, and with the free upper margin bent over throughout its whole extent. These eleven central denticles have no serrations. Then follow short, stout uncini, which gradually become longer and narrower, and finally are subulate. The number of these marginals is indefinite. They have about half a dozen minute serrations near their free end. These are not shown in fig. 18, though seen in fig. 17.

The operculum and radula of this species determine its location in the *Trochidae*, and not in the *Turbinidae*, and close to *Bankivia*. Fischer, Manuel de Conch., 1887, p. 810, places "*Leiopyrga*" as a genus provisionally in the vicinity of *Phasianella* with the remark, "the operculum is unknown." Pilsbry, in Manual of Conchology, vol. xi., p. 10, 1889, makes it a section of *Bankivia*, and at p. 139 refers to "the thin, membranaceous *Trochus*-like operculum" and "the teeth like those of *Margarita*," in Watson's description of the animal of *L. picturata*, H. & A. Adams. Our species has the same characters and should have the same place. It is quite possible it should have the same name. Tate diagnoses *L. octona* from *L. picturata* by three features: its conspicuous cinguli, its convex whorls, and its linear suture. But its cinguli vary in validity; in some examples they are valid in

all the spire whorls, in others the upper whorls show them plainly, but the lower whorls very indistinctly, though in the latter they are very valid over the base of the body whorl. In some *L. picturata*, from Port Jackson, sent to me by Dr. Cox, there are quite distinct indications of spiral cinguli on the spire whorls, though in most they are wanting. Our shells vary much in the convexity of their whorls. Some with well-marked cinguli are typically convex, others equally cingulated are almost straight-sided, whereas samples of *L. picturata*, from Port Jackson, may be convex. I am disposed to think Tate's species is no more than a validly spirally striate variety of *L. picturata*, Adams.

The colouration of our shell is just as variable as that of *Bankivia fasciata*, Menke. It may be wholly white, or purple, or may be banded or spotted or flamed or blotched, or zig-zagged with pink, brown, or yellow, in very pretty and abundant variety.

Hab.—Dredged in Investigator Strait, St. Vincent Gulf, Backstairs Passage, and off Newland Head; 15 fathoms, 3 dead; 17 fathoms, 8 alive, 9 dead; 20 fathoms, 10 dead; 22 fathoms, 2 recent, 42 dead.

***Cassidea sinuosa*, sp. nov.** Pl xxvi., figs. 7, 8, 9, 10a, b, c.

Shell roundly oval, thin. Nucleus of two and a half whorls, smooth, flatly rounded. Spire whorls, three, rounded, with spiral liræ, 13 in the penultimate; the posterior three are linear and adjacent, the next three flatly rounded; interspaces, at first equal in width to liræ, but becoming gradually narrower, till reduced to shallow, wide incisions. Oblique accremental growth lines, crossing liræ and interspaces. Suture linear, finely crenulate. Body whorl large. Suture linear, faintly channelled towards the aperture, where it slightly ascends. Sculptured with flat, broad, slightly raised liræ, least marked over the centre of the whorl; becoming gradually more valid towards the suture, and most valid anteriorly above the notch. Numerous subdistant, axial, accremental striæ, crenulating the suture, more valid and crowded towards the aperture. Aperture obliquely oval, widened anteriorly, compressed for about three millimetres posteriorly. Outer lip sinuous, projecting for about four millimetres below the suture, then receding in a shallow curve to the notch; slightly bevelled within, and faintly toothed. Some callus thickening inside the posterior projection, which is slightly incurved. Columella moderately arcuate, numerous oblique wrinkles on the lower half. Inner lip spread thickly over the varix of the notch, forming a small rhima above and below it, thinly but widely spread over the body

whorl to meet the outer lip. Notch well marked. Ornament, five spiral rows of quadrate rufous spots, one immediately below the suture, and one just above the notch, from eight to ten spots in each row. Length, 24 millimetres; breadth, 15; aperture, 16 by 7.

Hab.—Dredged in Investigator Strait, Backstairs Passage, and off Point Marsden, Kangaroo Island; in 15, 16, 17, 19, and 20 fathoms; 22 individuals, young and mature, alive and dead.

Diagnosis.—From *Cassis pila*, Reeve. It is more ovate, much less globular, and has no varix on the outer lip, which is sharp and peculiarly sinuous. From *C. Adcocki*, Sowerby. It is more elongate, has no longitudinal plicæ, the whorls are not angulated nor concave below the suture, there is no thick, granulated, infra-sutural band, there are no nodules on the last whorl, the labrum is not thickened, but is sinuous. It is not represented in the British Museum.

Its radula shows a single rachidian tooth, with a long, central cusp, and six gradually decreasing cusps on each side; a long lateral tooth, with about thirteen cusps, sloping obliquely inwards, and two uncini, not quite equal in size.

Variety A.—Is slightly narrower, being 19 mm. by 11, instead of 12. In place of five rows of rufous spots there are oblique, wavy, or curved brown radial bands, starting from a row of spots below the suture.

Obs.—The largest specimen is 27.5 mm. in length. When mature or senile there is a marginal linear thickening outside the labrum, which becomes well bevelled inside. In living specimens the ground tint is light pinkish brown, deeper on the nucleus and the earlier whorls. The number of spots in a spiral row varies considerably, even in the same shell, from 7 to 15.

***Cancellaria pergradata.* sp. nov.** Pl. xxvi., fig. 19.

Shell small, solid, brown, fusiform. Nucleus prominent, one turn and a half, apex imbedded, smooth, light horn colour. Spire whorls, three and a half, sharply angled. Behind the angle tabulate, with one tuberculate spiral lira. At the angle a stout spiral cord, coronate with about 25 sharp tubercles. Penultimate, with four very valid spiral ribs, not quite equal in width to the interspaces (which are as deep as wide), validly tuberculate, by narrow axial striæ, running from suture to suture, very obliquely from posterior suture to angle.

Body whorl, obliquely roundly pyramidal, with ten spiral cords rounded, about half as wide as the interspaces, crossed by 26 axial lamellæ, which form rounded tubercles at the junction, and coronate the stouter cord at the angle. Finer microscopic axial striæ cross the interspaces between the lamellæ.

Aperture obliquely oblong, narrowed and deviated to the left anteriorly, where it ends in a moderate-sized notch. Posteriorly square, external lip simple, thin, corrugated by the spiral ribs, uniformly slightly curved. Columella nearly straight, with two oblique anterior plates, inner lip as a thin glaze, not obliterating the spiral ribs on the base of the whorl.

Colour, uniform dark chestnut-brown.

Length, 10 millimetres; breadth, 5. Aperture length, 4.5 mm.; width, 3.

Hab.—St. Vincent Gulf, 17 fathoms, 2 broken, 1 recent; Backstairs Passage, 17 fathoms, 1 alive, 3 dead; 22 fathoms, 2 dead.

***Stephopoma nucleogranosum*, sp. nov.** Pl. xxvi., figs. 11, 12, 13.

Shell attached, solitary, or conglomerate. Nucleus horn-coloured or white; nautiloid, of one turn and a half; diaphanous, slightly effuse at its aperture; covered with minute granules, arranged in crowded lines corresponding with the accremental lines. The shell springs from within the slightly trumpet-shaped mouth, which projects all round and marks off the embryonic shell from the next whorl. Two and a half of these follow in the same plane, rather rapidly enlarging, and attached to the surface on which the shell rests; then come one or two whorls, coiled above and adhering to those below; and, finally, a free, more or less twisted tube, varying up to an inch in length. The attached whorls along their outer under surface throw out numerous scales of attachment at irregular intervals. The adherent whorls have a pronounced rounded carina along their upper outer part, which gradually becomes less valid along the free tube, until it may be indistinguishable. From this carina the side is flat to the carina of the whorl below, so that a young shell has the shape of a short cylinder fixed by one end on the rock, etc. There are moderately developed accremental striæ, which become ruder and rounder on the free tube.

Aperture circular, or very slightly elliptical.

Colour translucent white. Some are tinged more or less with pinkish-chestnut.

Operculum horny, multispiral; nucleus central, setigerous. Setæ comparatively narrow beyond the base of attachment,

then flatly expanded with numerous (perhaps eight) fine setæ on either side, beyond these the seta bifurcates; one part continues nearly in the same axis, and is the larger and longer; the other stands out at an acute angle and generally divides into two. Resting on the operculum, in the throat of the shell, may be three or four embryos, like minute nautilus.

Cylindrical portion about 6 millimetres in diameter and 4 or 5 high; aperture 3 or 4 in diameter.

Hab.—Backstairs Passage, from 16 to 23 fathoms, many alive.

I compared this species with a solitary small specimen in the British Museum, of unknown habitat, said to be a type of *Vermetus senticosus*, Mörch, and regarded it as identical. But a comparison of the nucleus of our shell with the description and figure of the type of Mörch's shell, given in P.Z.S., 1861, p. 150, pl. xxv., figs. 2 and 14, disproves this. The few large tubercles of his figure are quite different from the numerous minute granules of ours, and the 25 valid mammillæ at the periphery are wanting in ours. Then the form of the opercular setæ is quite dissimilar. Ours has not the expanded, sub-basal lamina he depicts, nor has his the bifurcation which ours always shows. His description indicates his possession of several shells, and not one only. Possibly the British Museum specimen may not have been the actual individual taken as the type, though resembling it externally, but may be the species now described.

***Nacella crebrestriata*, sp. nov.** Pl. xxvi, figs. 20, 21.

Shell oblong-ovate, laterally compressed, depressed conic. Apex subcentral, somewhat anterior; rounded, simple. About sixty radial riblets, rounded, about as wide as the interspaces; fine microscopic accremental striæ. Translucent, with an opaque, white apex, and a white flame in the centre of the upper half of the steep anterior slope; on the posterior slope, in its upper half, is a series of about seven opaque, white, concentric markings, consecutively increasing in transverse extent. The muscle scar is open towards the shorter end of the shell. Length, 3·8 millimetres; breadth, 2·1; height, 1·8; apex, 1·1 and 2·7 from the margin.

Hab.—"South Australia," from Professor Tate's collection; no more exact locality given. He had labelled it *Scutellina*; but that genus has the apex directed away from the opening of the muscle scar. Its size and shape recall our *Nacella parva*, Angas, from which it differs in being more solid and in its radial striation.

EXPLANATION OF PLATE XXVI.

- Fig. 1a. *Cadulus acuminatus*, Tate, rachidian, from the back.
 Fig. 1b. *Cadulus acuminatus*, Tate, rachidian, from the front.
 Fig. 1c. *Cadulus acuminatus*, Tate, rachidians, side view; diagrammatic.
 Fig. 2. *Cadulus acuminatus*, Tate, lateral.
 Fig. 3. *Cadulus acuminatus*, Tate, marginal.
 Fig. 4. *Cadulus acuminatus*, Tate, young.
 Fig. 5. *Cadulus acuminatus*, Tate, adult.
 Fig. 6. *Cadulus acuminatus*, Tate, adult, turned round.
 Fig. 7. *Cassidea sinuosa*, Verco, profile.
 Fig. 8. *Cassidea sinuosa*, Verco, ventral view.
 Fig. 9. *Cassidea sinuosa*, Verco, protoconch.
 Fig. 10a. *Cassidea sinuosa*, Verco, marginals.
 Fig. 10b. *Cassidea sinuosa*, Verco, lateral.
 Fig. 10c. *Cassidea sinuosa*, Verco, rachidian.
 Fig. 11. *Stephopoma nucleogranosum*, Verco, adult.
 Fig. 12. *Stephopoma nucleogranosum*, Verco, young.
 Fig. 13. *Stephopoma nucleogranosum*, setæ from operculum.
 Fig. 14a. *Dentalium intercalatum*, Gould, var. *Bednalli*, Pilsbry, lateral.
 Fig. 14b. *Dentalium intercalatum*, Gould, var. *Bednalli*, Pilsbry, rachidian.
 Fig. 14c. *Dentalium intercalatum*, Gould, var. *Bednalli*, Pilsbry, marginal.
 Fig. 14d. *Dentalium intercalatum*, Gould, var. *Bednalli*, Pilsbry, accessory plate.
 Fig. 15. *Liopyrga octona*, Tate, operculum. a.a. Marginal fringe. b.b. Spirals.
 Fig. 16. *Liopyrga octona*, Tate, rachidian and laterals, one side.
 Fig. 17. *Liopyrga octona*, Tate, last marginal.
 Fig. 18. *Liopyrga octona*, Tate, first marginal.
 Fig. 19. *Cancellaria pergradata*, Verco.
 Fig. 20. *Nacella crebrestriata*, Verco, side view.
 Fig. 21. *Nacella crebrestriata*, Verco, dorsal view.